



VBOX AQUAPLANE SOFTWARE MANUAL

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1. Introduction

Every vehicle function that changes direction or speed, from turning to accelerating to braking, places a load on the tyres.

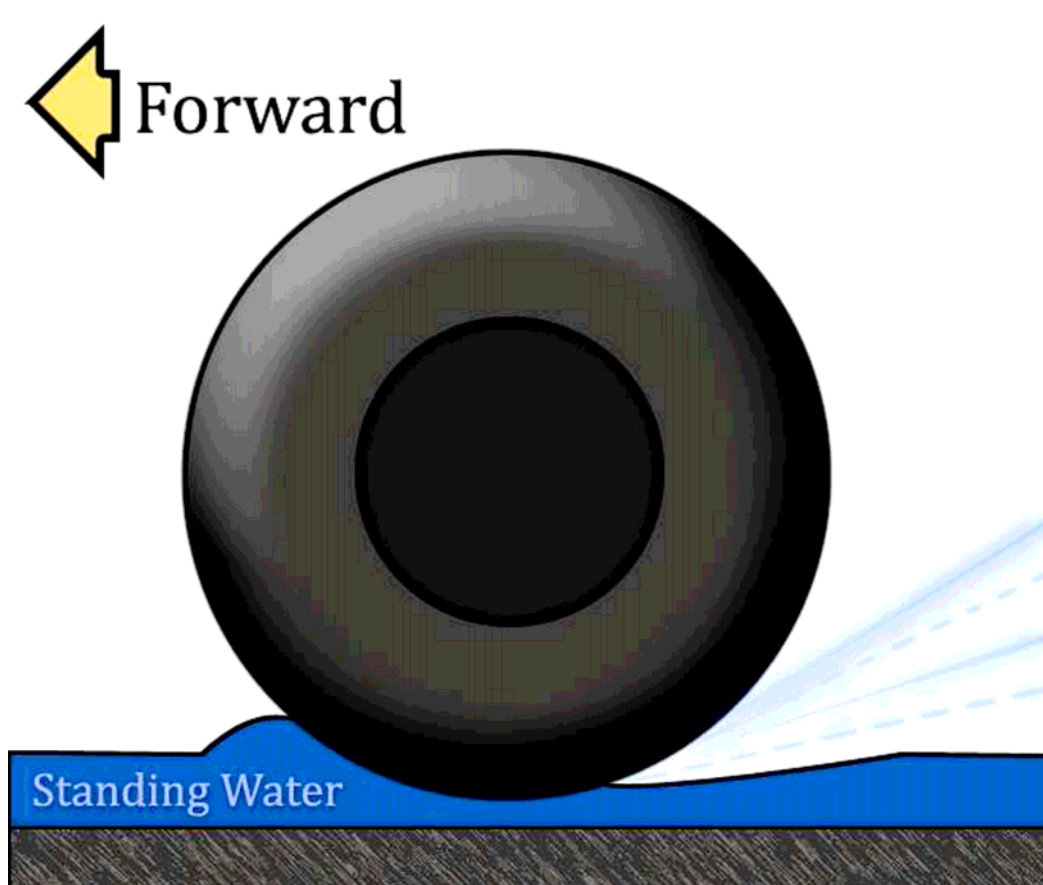
Control of this load relies on the friction between the tyre and the road surface. More friction makes for a greater resistance to slipping; so a reduction in friction, such as in wet road conditions, may lead to the driver losing control.

Aquaplaning by a vehicle occurs when the water between the vehicle's tyres and the road surface cannot be displaced, leaving a permanent layer of water between the tyres and the road surface. This causes the wheels to slip and prevents the vehicle from responding to inputs such as steering, braking or accelerating. As a result the vehicle can go out of control, particularly if the steered wheels are involved.

Tyre manufacturers need to consider the ability of a tyre to remove excess water from the road surface, which is a function of the vehicle speed and the tread pattern.

The Racelogic solution breaks the testing down into a simple calibration run immediately followed by the test run – the non-aquaplaning wheel speed information is stored and recalled automatically by the software for determining the point of aquaplaning.

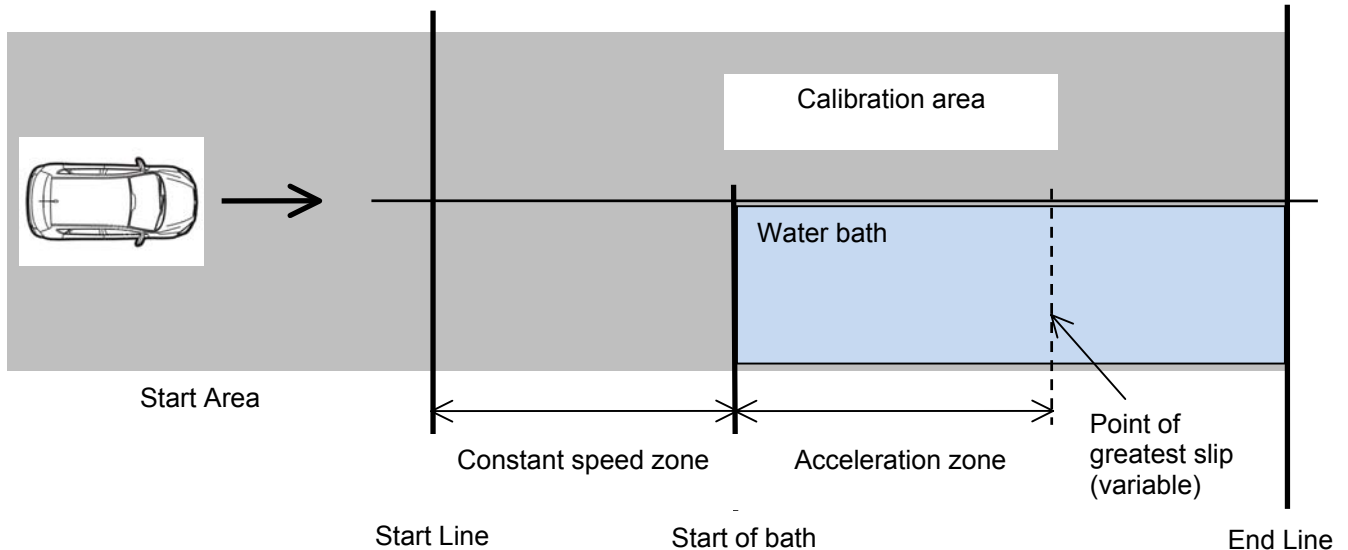
The VBOX aquaplaning software is designed for use with any VBOX except the VBOX Mini and VBOX Micro.



Tyre cannot displace all of the standing water on the road, leaving a layer of water between it and the road surface.

2. Aquaplaning Test - Theory

In order that various tyre tread patterns can be evaluated fairly, aquaplaning tests will need to be performed under consistent conditions, such as given below:



Using the test layout given above, the general procedure is as follows:

- Prior to test, a calibration of the wheel speeds in dry conditions must be performed by driving between the start line and end line in the dry calibration area. This gives a ratio of Wheel Speed against GPS speed and this ratio is saved and used to calculate the % slip change between driving on a dry surface and driving on a wet surface.
- Return to the beginning of the test and accelerate to the required speed before reaching the start line (45mph for example).
- Hold this speed until the beginning of the water bath.
- Accelerate in the water with an immediate application of full throttle until aquaplaning occurs – the point of aquaplaning being defined as a pre-set percentage change in the ratio of actual wheel speed against GPS speed of one or more wheels.
- The distance travelled in the water prior to aquaplaning, combined with the speed reached at this point, can then be used as a measure of the tyres resistance to aquaplaning.

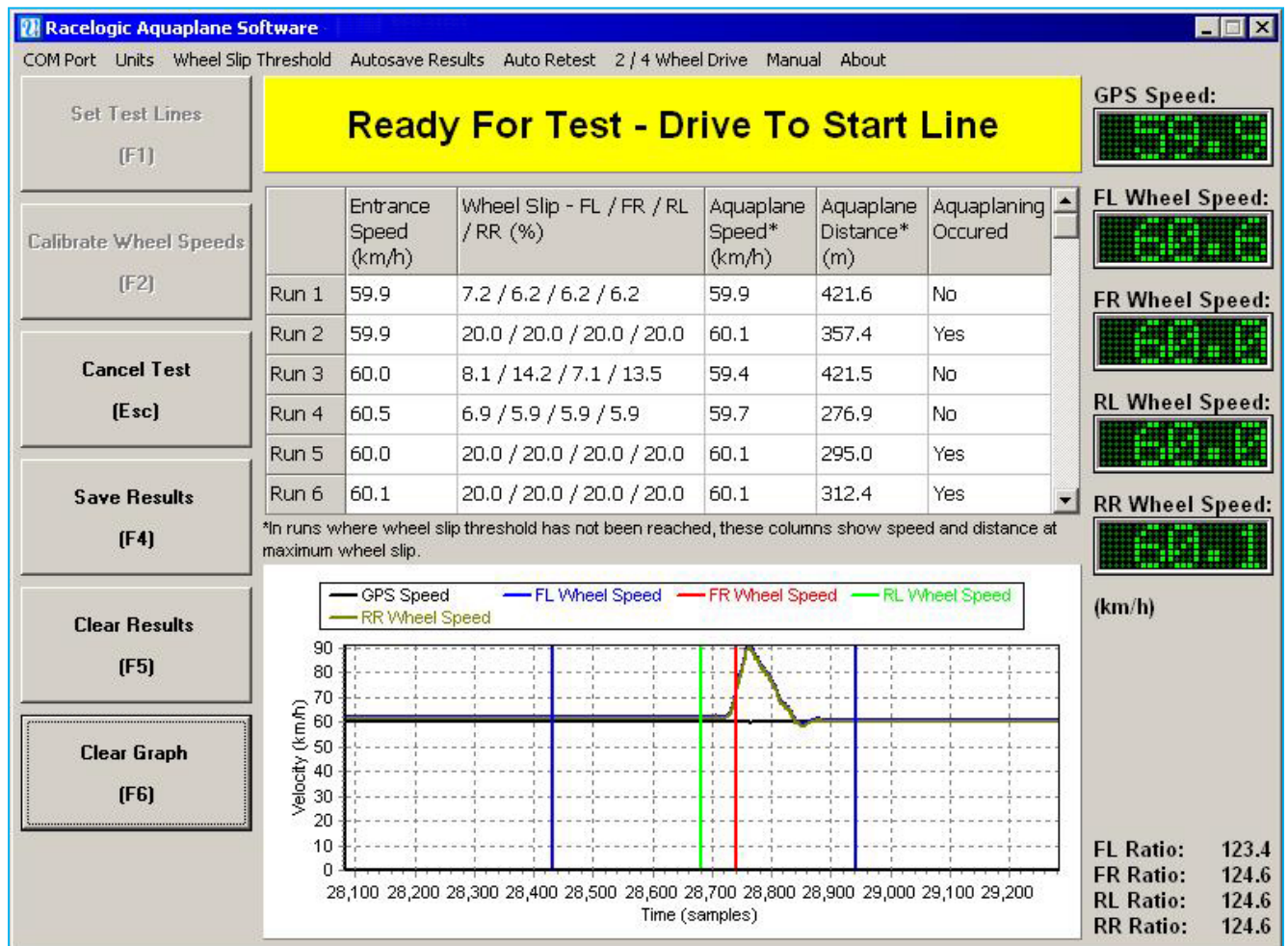
3. Software Installation

The VBOX aquaplaning software must be installed onto the hard drive of a computer; it cannot be run from the installation CD.

To install the software insert the CD into the CD drive of your computer, then follow the on-screen instructions. If you already have a DEMO version of the software installed on your PC, you will not need to uninstall this.

After successful installation, a shortcut  will be added to your computers desktop.

The VBOX aquaplaning software is not limited to one user or computer - it can be installed on more than one computer, but it can only be used by the department that it is licensed to.



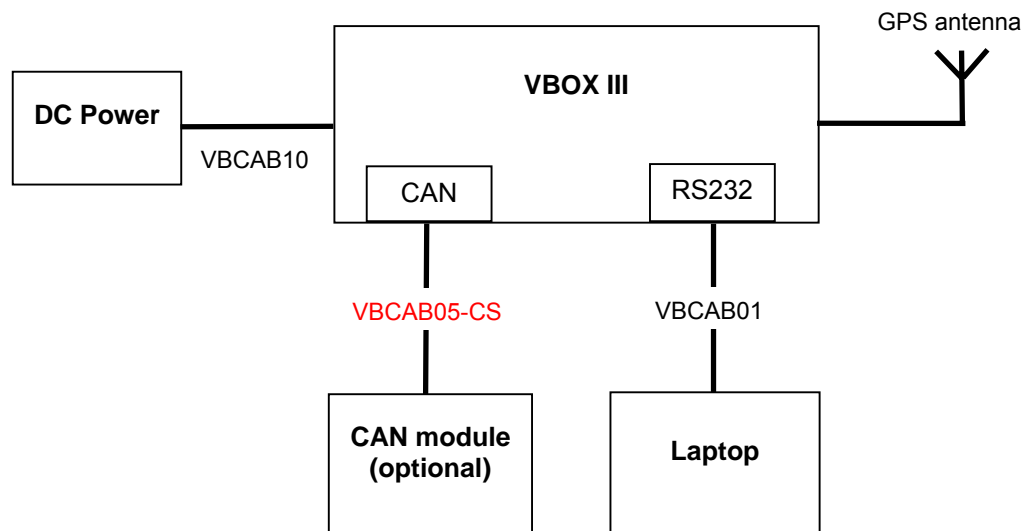
Typical software screen shot – 4WD Vehicle

4. Getting Started

STEP 1: Setting up the VBOX on a Vehicle

Set the up the VBOX on your vehicle as instructed in the VBOX user manual.

Block diagram of typical system set-up



STEP 2: Configuring the VBOX with VBOX Tools

Prior to setting up and performing the aquaplaning test, the VBOX will need to be configured to ensure that it is in the correct operating mode for the test, particularly important if your VBOX is used for other types of testing as well.

NOTE: Once this is done it will not need to be repeated providing that the VBOX configuration does not get altered.

The following instructions should be followed using your VBOX Tools software manual as a reference.

- Open VBOX Tools software (If your software is not registered at this point , please do this in accordance with the instruction in the software manual).
- Next click on the **VBOX Set-up** Icon. A dialogue box will open to allow you to configure the VBOX.
- Select **Channels ► Standard** and then ensure that all channels from listed from **Satellites** to **Trigger event time** are ticked for sending over serial. It is good practice to ensure that these are also ticked for logging to compact flash.
- Select the **Internal A-D** window and ensure that every box is un-ticked.
- You will now need to configure the VBOX for the incoming wheel speed data and there are a number of set-up options for this:
 1. **If you are using a VCI enabled VBOX and reading Wheel speed information over the CAN bus:**
 - Configure each required input channel with the corresponding Vehicle can information.
 - Ensure that the wheel speed are assigned to the first 2 or 4 channels of the VCI channels.
 - Ensure that each required wheel speed channel is enabled for logging and transmission over serial.
 2. **If you are using a VBOX with Wheel speed sensors & FIM03**
 - Connect the FIM03 to the CAN socket of the VBOX.
 - Connect the raw wheel speed signals to the inputs of the FIM03.

- Enter VBOX setup through VBOXTools and click on the FIMS03 Tab.
- Ensure that each required wheel speed channel is enabled for logging and transmission over serial.
- Ensure that each required channel is set to 'Frequency' mode. Note it is not required to configure the FIM03 channels to speed as the Aquaplane software does this automatically during the Calibration phase.

3. If you are using a Non-VCI enabled VBOX with CAN02

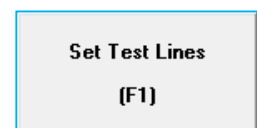
- Connect the CAN02 to the CAN socket of the VBOX.
 - Connect the Vehicle CAN bus to socket 4 of the CAN02.
 - Enter VBOX setup through VBOXTools and click on the VCI tab and confirm that the tab shows the serial number of your connected CAN02.
 - Configure each required input channel with the corresponding Vehicle can information.
 - Ensure that the Baud rate is set correctly for the connected Vehicle CAN bus
 - Ensure that each required wheel speed channel is enabled for logging and transmission over serial.
- Select the **Logging Tab** and ensure that:
 - Serial o/p is set to maximum for the VBOX, **this must be 20Hz for the VB3**. If USB or Bluetooth is being used on the VB3i, then the data rate will automatically be 100Hz.
 - CF log rate is set to the maximum log rate for the VBOX being used (for example 100Hz VB3/VB3i, 20Hz for VB2SX)
 - Log conditions is set to Log only when moving
 - Select the **GPS Tab** and ensure that:
 - Kalman filter velocity option is set to zero.
 - GPS Optimisation – This should be set to high dynamics to ensure the maximum accuracy in determining the difference between wheel speed and GPS speed.
 - Close VBOX Tools

STEP 3: Opening the Aquaplane software and establish communication

- Ensure VBOXTools software is closed so that it does not hold the COM port.
- Click on the Aquaplane Software desktop shortcut to open the software.
- In the click on the "COM Port" drop down menu and select the correct COM port for the Aquaplane software to use.

STEP 4: Defining test lines

- Referring to the diagram in section 2, you will now need to set the various test points required. Select "Set Test Lines" from the operational buttons on the left hand side of the screen, or hit F1
- The "Waiting to set: START LINE" dialogue box will now be displayed. Drive to the required start line and either click on the "Set line" (Spacebar) button, or simply just hit the spacebar to set this start line in the software. If at any stage you need to abort the process of defining the test lines, you can do so by clicking "Cancel (Esc)", or by hitting the Esc key. This will return you to the start of set test lines procedure
- Once the start line is set, the dialogue box will display "Waiting to set: START OF BATH", so you can now proceed to define the water bath. Continue driving to the start of the water bath and set this position in the software by either pressing the "Set line (Spacebar) button, or hitting the Spacebar.



- Once the START LINE is set, the dialogue box will now display “Waiting to set: END LINE”, so you can now define the end of the test. Continue driving to the end line and set this position in the software by either pressing the “Set line (Spacebar)” button, or hitting the Spacebar.

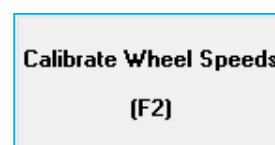


- The test lines are now set. You can now proceed to calibrate the GPS speed against the wheel speed.

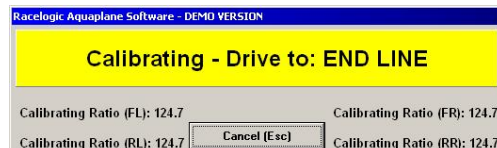
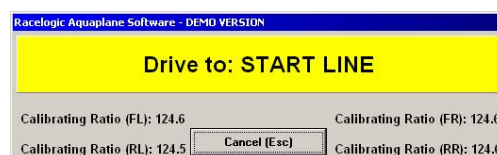
STEP 5: Calibrating the GPS Speed against the wheel speed

NOTE: You do not need to perform the calibration run at the same speeds at which the test will be run at – the calibration run is performed on a dry surface with no occurrence of wheel slip and so the ratio of GPS speed to wheel speed will be the same, regardless of the speed of the vehicle.

- To calibrate the GPS speed against the wheel speeds, return to a position a little distance before the start line and either click “Calibrate Wheel Speeds” from the operational buttons on the left hand side of the screen, or hit F2.

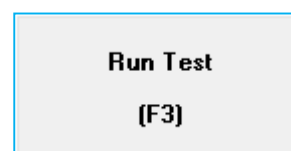


- A dialogue box will open instructing you to “Drive to: START LINE” Drive to the start line and continue at a steady speed. If at any stage of the calibration run you need to abort the process, you can do so by clicking “Cancel (Esc)”, or by hitting the Esc key. This will return you to the start of the calibration procedure.
- Once you have crossed the start line, the message in the dialogue box will change to “Calibrating – Drive to: END LINE” Hold the vehicle speed at a constant speed and continue driving until you have passed the end line set previously.
- After crossing the end line, the software will calculate the ratio of GPS speed against wheel speed and store this for use during the test run. Upon successful calibration, the dialogue box will change to show the message “Ratios Successfully Calibrated”
- You can now perform the aquaplane test.



STEP 6: Performing the aquaplane test

- Once you have calibrated your wheel speeds, you can proceed to perform the aquaplaning test by simply driving back round to the start area and either clicking the “Run Test” button, or pressing F3. Upon starting the test, the “RUN Test (F3)” button will change to “Cancel (F3)”. If you need to stop the test before it is completed, you can use this button to do so.
- Drive over the start line at the required speed and hold this speed constant until you reach the start of the water bath.
- At the start of the water bath, apply full acceleration and continue driving in a straight line into the water bath.



- Keep the accelerator fully depressed, and continue driving in a straight line until either the point of aquaplaning is reached, or you come to the end of the water bath.
- The results are reported in real time, in both numerical and graphical format. The table of results reports the speed at which the water bath was entered, the percentage change of wheel slip for each wheel, the speed at which the point of aquaplaning occurred, the total distance from the start line (not start of water bath) at which the point of aquaplaning occurred and a Yes/no column to indicate whether the point of aquaplaning was actually reached or not.
- Once you have completed the test, click “Save Results (F4)” to save the results to both a .txt and .vbo file. The .txt file can be reviewed in notepad and the .vbo file can be reviewed in the VBOXTools data analysis software provided with your VBOX. Note if you have selected “Autosave Results” (see page 14), you do not need to manually save these.
- If for any reason during the test you want to start again, you can do so by clicking “Clear Results (F5)”, or by pressing the F5 key. This will return you to the start of the test, but keeps the test line conditions and GPS speed/Wheel speed calibration data. If “Autosave Results” is selected, this data will be saved to the .txt and .vbo files
- if you want to clear the history from the graph screen, you can do so by clicking “Clear Graph (F6)”, or by pressing the F6 key. This will remove all previous results from the graphical trace.
- You can repeat the test simply by returning to the start area and driving again. You do not need to press Run Test (F3) again. This allows you perform the test continuously, but at different water bath entry speeds. For example, if the test starts at 10kmh entry speed, aquaplaning may not occur in the water bath. You can then simply drive back round and repeat the test again, but with a 20kmh water bath entry speed and so on, until aquaplaning DOES occur.

**Save Results
(F4)**

**Clear Results
(F5)**


**Clear Graph
(F6)**

	Entrance Speed (km/h)	Wheel Slip - FL / FR / RL / RR (%)	Aquaplane Speed* (km/h)	Aquaplane Distance* (m)	Aquaplaning Occured
Run 1	30.0	6.9 / 5.9 / 5.9 / 5.9	34.2	321.6	No
Run 2	40.0	7.2 / 6.2 / 6.2 / 6.2	43.5	313.5	No
Run 3	50.0	8.1 / 14.2 / 7.1 / 13.5	60.1	320.0	No
Run 4	60.0	20.0 / 20.0 / 20.0 / 20.0	79.9	276.9	Yes
Run 5					
Run 6					

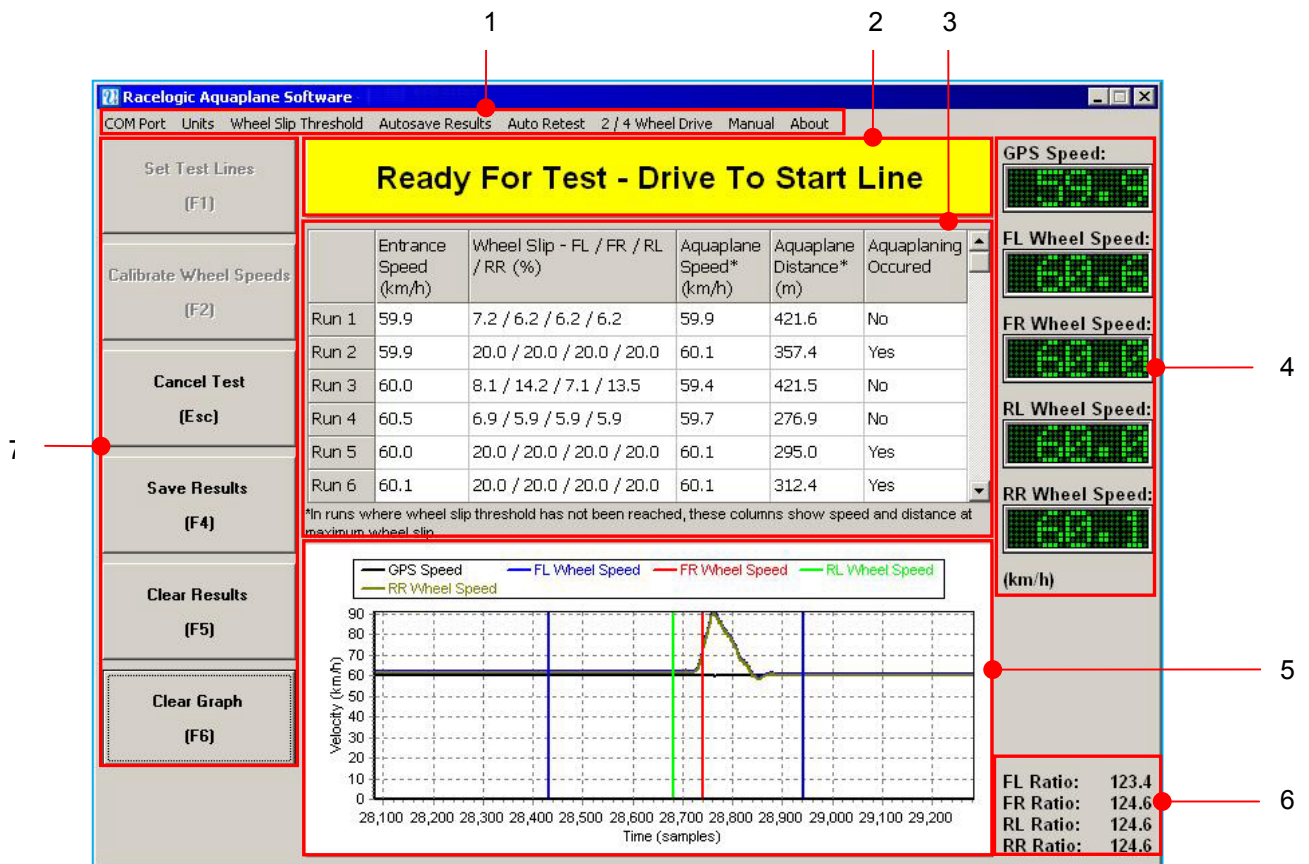
*In runs where wheel slip threshold has not been reached, these columns show speed and distance at maximum wheel slip.

Example of tests performed at incrementing speeds until aquaplaning occurs

5. Software Functions overview

When you double click the Aquaplane software icon , the Racelogic logo and licensee details will appear for a few seconds and then the software will open directly to the main screen, as given below.

Software screen layout



1. Menu / set-up buttons:

Allows the user to define all test conditions

2. Test status indicator:

This indicates the current status of the test in real time, in both English text and in a colour coded system.

3. Table of test results

Results table showing run number, GPS and wheel speeds with individual wheel ratios, distance covered prior to aquaplaning and a simple yes/no as to whether aquaplaning, as defined by the % ratio increase, occurred at all.

4. Numerical speed indicator

Gives large, easy to read numerical information on real time GPS speed and individual wheel speeds.

5. Speed Vs. Time graph:

Real time graphical representation of GPS speed and individual wheel speed.

6. GPS Speed / Wheel speed ratios:

Real time indication of ratio of GPS speed to wheel speed. Shows ratio for each individual wheel.

7. Operational buttons:

Click these to commence various actions during the test procedure.

6. Software Configuration and Test Set-up

Before performing the test, you will need to set certain parameters to suit your test requirements. These are set using the various drop-down menus accessed via the Menu/Set-up buttons (Item 1 page 10)

Menu / set-up buttons

COM Port

To enable communication between the PC and the VBOX, you will need to define the appropriate communications port to allow the devices to “talk” to one another

To do this select:

- ▶ COM Port
- ▶ then choose appropriate COM port - for example COM 4

COM Port
COM 1
COM 2
COM 3
COM 4
COM 5
COM 6

Units

This allows you to define the speed units in either mph, km/h or knots and the distance units in either metres or feet.

To select speed units, select :

- ▶ Units
- ▶ Speed
- ▶ then click the required units.

Units	
Speed ▶	mph
Distance ▶	✓ km/h
	knots

To select distance units, select:

- ▶ Units
- ▶ Distance
- ▶ then click the required units.

Units	
Speed ▶	
Distance ▶	✓ metres
	feet

Wheel Slip Threshold

This allows you to define the percentage slip to apply to the wheel speed / GPD speed ratio, to determine the point of aquaplaning.

To select distance units, select:

- ▶ Wheel Slip Threshold
- ▶ then manually insert the required % in the white box.

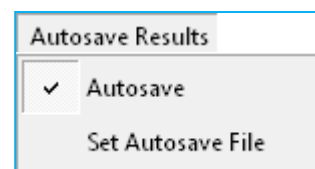
Wheel Slip Threshold
Wheel Slip Threshold (%) 20

AutoSave Results

This option allows you to automatically save the test results as a .txt file when the test is complete.

To select Autosave results, select:

- Autosave Results
- then click Autosave. This option will then be ticked to show that autosave is enabled.

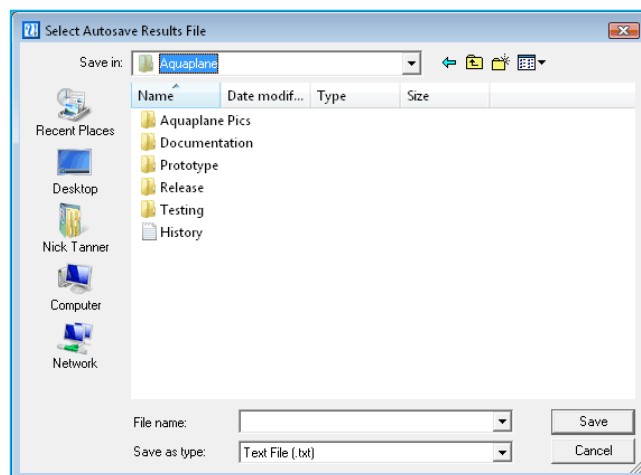


When you have enabled Autosave results, you will need to define where you want the results to be saved to.

To define the file location: select;

- Autosave Results
- Set Autosave File

This will then bring up the PC directory structure. Navigate to where you want the results to be saved to, give the .txt file a name and click Save. When the test is completed, the results will automatically be saved to this file.

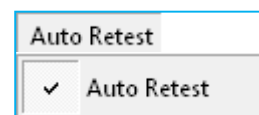


Auto Retest

This option allows you to repeat the test without having to press the Run Test or F3 button. This is particularly useful if you need to repeat the test a number of times for statistical purposes. The .txt results file will be updated automatically with each execution of the test – there is no need to save the file between runs.

To enable Auto Retest, select;

- Auto Retest
- then click Auto-Retest. The option will then be ticked to show that auto-retest is enabled



2 / 4 Wheel Drive

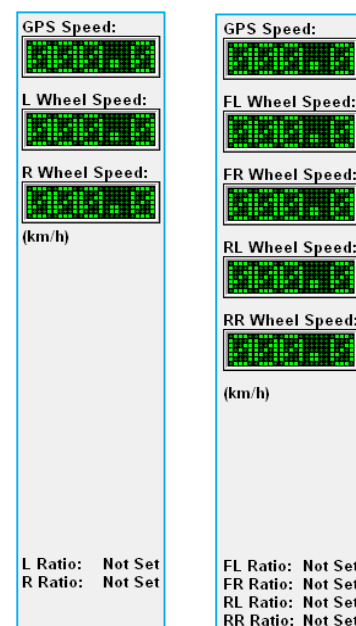
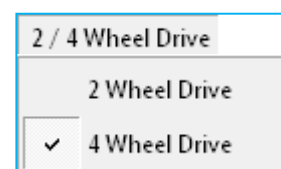
This option allows you to define whether the test is to be performed on 2 driven wheels or two steered wheel (for a 2 wheel drive vehicle), or 4 driven wheels (for a 4 wheel drive vehicle)

To choose between 2 wheel drive and 4 wheel drive, select;

- Auto Retest
 - then click either “2 Wheel Drive” or “4 Wheel Drive”
- The selected option will then be ticked to show that it has been enabled

When 2 wheel drive is enabled, the numerical speed indicators will show data for GPS Speed, left (L) Wheel Speed and right (R) Wheel speed. The GPS Speed / Wheel speed ratios will be enabled for just the left and right wheels.

When 4 wheel drive is enabled, the speed and ratio is displayed for all four wheels – Front Left (FL), Front Right (FR), Rear Left (RL) and Rear Right (RR)



Manual

Clicking "Manual" opens a PDF copy of this user manual.

About

Clicking "About" brings up the following information about the software version, Racelogic contact details and PC performance.



7. Reviewing Saved Results

Because aquaplaning is a real-time test, there is presently no function to replay saved results in this software. All data shown on-screen in the results table is saved as a .txt file on the PC.

8. Troubleshooting

No Satellite Lock

- Check that the antenna connection is clean and secure.
- Check the antenna cable for any damage.
- If a second antenna is available use this to eliminate the possibility of an antenna fault.
- Perform a GPS cold start and then leave the VBOX connected to the antenna and powered up in an open, static position for 15 minutes.

No Communication

- If the Power LED on the VBOX is not illuminated then there is no power to the unit; check that battery is charged or, if using a cigar lighter, check internal cigar lighter fuse.
- Check that the serial cable (CAB01) is plugged into socket RS232 on the VBOXIII.
- Check that the serial cable is plugged into the COM port of the PC.
- Check that the USB cable is correctly connected if USB is being used.
- Check that no other programs are using the same COM port.
- Try going into 'VBOX Set-up', and then exiting again.
- Disconnect the power to the VBOX, then reconnect it.

COM Port Unavailable

- The computer may have been started with a VBOX connected to it; disconnect the VBOX, restart the computer then reconnect the VBOX.
- Another software package installed on your computer may have reserved the COM port.

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9. Contact Information

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Revision	Date	Description	Author
1.0	23/12/2008	First release	NT
1.1	13/3/2008	Amendments to setup procedure.	KB